PRELIMINARY NOTES ON SOME IGNEOUS ROCKS OF JAPAN*[1]

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COMENDITE

This remarkable rock is found as blocks in a small stream running into the Bay of Iibi, a small village on the northeastern coast of Dōgo. The environs of the village consist mainly of schistose granitic rock and its porphyries, in association with rhyolites. Though the exposure of the comendite was not observed by the writer and its geological occurrence cannot be stated at present, it seems highly probable that the rock is a differentiated and effusive form of the same magma from which the above-mentioned rocks were derived.

Megascopically, the rock is light gray with a bluish tone and exhibits a distinct wavy flow structure, produced by the arrangement of feldspar crystals and lighter-colored crystalline bands, and has a tendency to platy parting under the hammer. Numerous phenocrysts are quartz and feldspar. The quartz is conspicuous, with rounded outline, and varies in diameter from 1 mm. to 3 mm. The feldspar is glassy, fairly well defined, and prismatic or tabular, from 1 mm. to 5 mm. in length, the prevailing length being 2 mm. Megascopic phenocrysts of colored minerals are rare. The groundmass shows a certain diversity of texture, some parts being aphanitic and compact, and some parts more crystalline and lighter in color. This property produces the fluxion structure already mentioned.

Microscopically, the constituent minerals are quartz, alkali-feldspar, arfvedsonite, barkevikite, aegirite, aegirite-augite, titaniferous iron, magnetite, and apatite. The conspicuous pheno-

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[1] A continuation of Paper VI, on "Quartz-Syenite and Comendite from the Oki Islands," published in the issue of this Journal for October–November, 1912.

crysts are quartz and feldspar, the latter being more abundant. Besides these, there are present bluish-green and deep reddish-brown ferromagnesian minerals belonging to the pyroxene and amphibole groups. These are fewer and smaller than the colorless phenocrysts. The groundmass is strongly marked with flow structure, due to both the diversity of crystallinity and the arrangement of constituent minerals. The greater part shows a microfelsitic texture, essentially composed of quartz and feldspar, through which are scattered numerous small ragged shreds or mosslike patches of aegirite and aegirite-augite, associated with minute grains of magnetite. A microspherulitic intergrowth is also seen. Through this fine groundmass are coarser crystalline bands, mainly composed of feldspar and quartz with subordinate green pyroxene, developed in a lenticular form. The mode of development of these minerals exhibits some peculiarities. The minerals occurring in the marginal part of the lenticular area are arranged perpendicular to its outline, but those in the inner part show a microgranitic or micropegmatitic arrangement.

The quartz phenocrysts are mostly subhedral, sometimes anhedral, with diameters varying from 0.05 mm. to 3 mm., but euhedral forms are also seen. The mineral contains several kinds of inclusions. Glass inclusion with or without a gas bubble is not rare. They are commonly bounded by crystal planes. There are abundant inclusions of groundmass material, showing irregular forms. Aegirite groups are also inclosed.

The feldspars are wholly alkalic, and almost all of them are possibly soda-bearing potash varieties, though a few crystals appear to be sanidine. The phenocrysts occur in two shapes, tabular or columnar, and are commonly subhedral. In some instances, the outline is strongly rounded and curved, and is deeply invaded by the groundmass. Some crystals have a regular shape, fairly well inclosed by crystallographic faces. The twinning observed is wholly Carlsbad, and no microcline structure is noticeable. The feldspar material is entirely fresh and is plainly marked by the cracks characteristic of sanidine. The plane of the optic axes appears to be perpendicular to (010). The acute optic angle (2E), measured on three thin sections, is 56° 34′, 50° 16′, and nearly

zero. The optical character is negative. Inclusions are common. The most abundant are of groundmass material, as is the case with

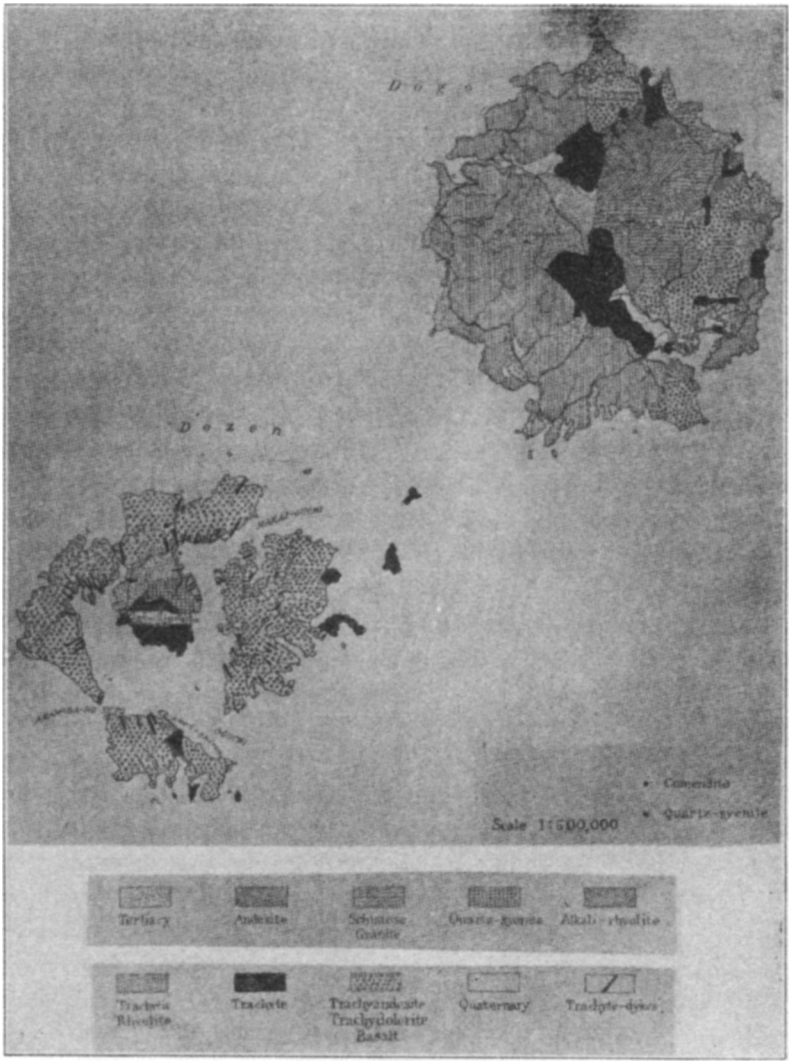

FIG. 3

the quartz phenocrysts. Quartz is frequently inclosed, and pyroxene and glass are also seen.

The ferromagnesian minerals belonging to pyroxene and amphibole groups are arfvedsonite, barkevikite, aegirite, and aegirite-augite. The amphiboles occur as phenocrysts, and the pyroxenes both as phenocrysts and in the groundmass. The phenocrysts of these minerals are usually found in association. Barkevikite occurs irregularly intergrown with the arfvedsonite on the one hand, and with the aegirite and aegirite-augite on the other. Their shapes are elongated or short prismoid, but their outlines are irregular and ragged. No cross-section was found in ten thin slices made for the purpose of determining the cross-section. So the determination of the optical orientation of the minerals was difficult. The aegirite-augite is distinguishable from the aegirite by its higher birefringence and larger extinction angle, reaching $c \wedge X = 37°$. From the aegirite, the arfvedsonite is distinguishable by the extinction angle and its direction, compared with those of the barkevikite associated with them. The aegirite extinguishes at a small angle or nearly zero in β, in which the barkevikite extinguishes also, while the arfvedsonite extinguishes in $-\beta$. On a longitudinal section, the extinction of the barkevikite was measured as $c \wedge Z = 2°$, and the arfvedsonite showed $c \wedge X = 15°$ in concurrent direction. Some crystals are strongly decomposed and are completely altered into a yellowish-brown substance. There are a few minutes rods to be identified as aenigmatite in the groundmass. They are deep brown or almost opaque.

Chemical character.—A chemical analysis of the rock, made by K. Yokoyama in the chemical laboratory of the Survey, compares fairly well with those of the comendites from other localities, described by different authors. It shows well its characteristic properties: high alkalies and nearly equal amounts of soda and potash, low lime and magnesia, fairly high iron oxides, and low alumina in proportion to alkalies and silica.

The analysis of the rock from the Oki Islands is given under column A in the following table, and is compared with those of the comendites from Comende, Sardinia (B)[1], and Iskagan Bay, East Siberia (C).[2] They resemble one another very closely, though

[1] H. Rosenbusch, *Elemente der Gesteinslehre*, 3. Auflage, p. 332.

[2] H. S. Washington, *American Journal of Science*, XIII (1902), 180.

the rock from the Oki Islands differs from the others in lower silica and in total and relative amounts of iron oxides.

	A	B	C
SiO_2	72.21	74.76	75.44
Al_2O_3	11.20	11.60	11.98
Fe_2O_3	2.25	3.50	0.88
FeO	2.66	0.19	1.02
MgO	0.08	0.18	0.10
CaO	0.27	0.07	0.33
Na_2O	4.29	4.35	4.06
K_2O	4.81	4.92	5.01
H_2O+	1.45*	0.64	0.68
H_2O-	....	....	0.13
TiO_2	0.44	Trace	Trace
P_2O_5	0.10	Trace	....
MnO	0.10	Trace	Trace
Total	99.89	100.21	99.63

* Loss on ignition.

A. Comendite from Iibi, Dôgo, Oki. K. Yokoyama analyst.

B. Comendite from Comende, Sardinia. M. Dittrich analyst.

C. Comendite from Iskagan Bay, East Siberia. H. S. Washington, analyst.

Norms of these rocks are given in the following table:

	A	B	C
Quartz	28.3	31.6	31.9
Orthoclase	28.4	28.9	30.0
Albite	30.9	32.0	33.0
Acmite	4.6	4.2	0.9
Diopside	0.5	....	....
Hypersthene	3.4	0.5	2.1
Magnetite	0.9	0.7	0.9
Hematite	....	1.6	....
Ilmenite	0.9	....	....
Apatite	0.3	....	....

From the above table, it will be seen that the rock from the Oki Islands is closer to that of Comende than that of Iskagan Bay and is richer in femic minerals than the other two.

The ratios of the Oki rock are as follows:

$$\frac{\text{Sal}}{\text{Fem}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 8.26$$

$$\frac{\text{Q}}{\text{F}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 0.48$$

$$\frac{K_2O'+Na_2O'}{CaO'} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad \infty$$

$$\frac{K_2O}{Na_2O} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad 0.86$$

By the *Quantitative System*, the rock may be classified under the name liparose, in which the other two comendites from Comende and Iskagan Bay belong also.